Inefficiency of automatically linking unemployment benefits to private sector wage rates

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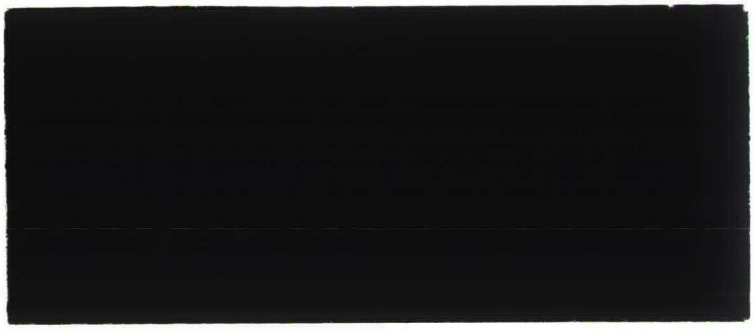

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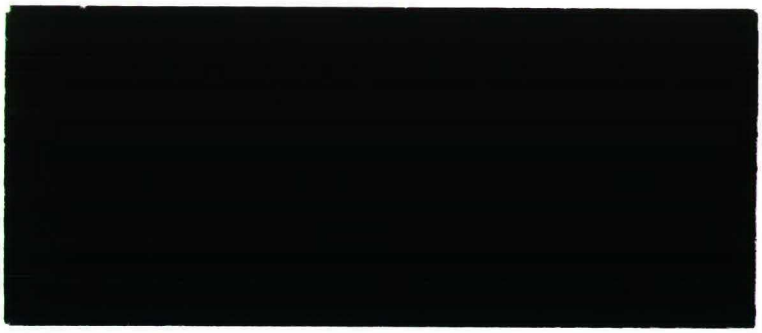

INEFFICIENCY OF AUTOMATICALLY LINKING UNEMPLOYMENT BENEFITS TO PRIVATE SECTOR WAGE RATES

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Abstract

To ensure that the level of benefits keeps pace with the general welfare development, governments sometimes fix the replacement ratio by linking benefits automatically to private sector wage rates. In this paper the effects of introducing an automatic link between unemployment benefits and private sector wages rates, are shown in the context of a game between employers, an encompassing trade union federation and the government. The by far most likely outcome of introducing such a link, is that the unemployment rate will rise and output will be reduced, because the incentives for the trade union federation of raising the wage rate are larger when unemployment benefits are linked to private sector wage rates.

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1. Introduction

An important question governments face is how to set benefit levels and how to change these benefit levels when economic circumstances such as the level of general welfare change. Some governments have yielded to the temptation to link benefit levels automatically to private sector wage levels through index mechanisms as a simple and apparently just answer to this question. Such benefit linking mechanisms have existed for example in the Netherlands for over ten years (van Drimmelen & van Hulst 1981). Similar mechanisms can to some extent be found in other countries.

An automatic link between unemployment benefits and real wages rates can have rather undesirable effects however. The existence of an automatic link between unemployment benefits and private sector wage rates can explain the lack of wage adjustment which made the Dutch disease so painful in the Netherlands (Kremers 1986). Because unemployment benefits were linked to the wage rates in both the international and the relatively flourishing domestic sector, and the minimum pay out is equal across the sectors, the linking mechanism will have hindered the adjustment of the wage rates in the international sector to changed circumstances. This lack of wage adjustment in turn created a snow ball effect because the unemployed resulting in the course of this process landed on the public sector payroll in the form of genuinely unemployed or in the form of disguised unemployed, such as many of the industrially disabled (see Halberstadt 1978 and table 1).

Table 1. The shift from private to public sector pay roll

	1963	1973	1983
		(x1000)	
Number of people on the public sector pay roll:	1995	2890	4205
- economically active	605	820	1070
- economically inactive	1390	2070	3135
Number of people on the pay roll in the private sector:	3560	3575	3240

Source: De Nederlandsche Bank, Annual report 1983

As a result public sector expenditure rose rapidly, leading to a vast government deficit (up from 0% in 1973 to 4.5% of GDP in 1979) and high tax rates (the share of conventional non-gas taxation and social security contributions rose from 42% to 46.5%) even though revenue from gas taxation by itself meant an extra income of roughly 2.5% of GDP in 1979 and 5.5% in 1982). The increased tax rates and rates of social security contributions aggrevated the original problems of wage adjustment by creating an upward pressure on gross wage rates. This worsened the situation especially in the international sector, wiping out both profits and employment (see table 2).

Table 2. Labours share* in value added

	1964/ 1968	1969/ 1973	1974/ 1978	1979/ 1983
	(average percentages)			
Industry,	72.5	74.5	84	92
Service sector	75	78.5	79	74

* Labours share equals total labour cost including employers contributions and imputed income of self-employed, divided by net value-added at factor costs.

Source: Central Planning Bureau, Centraal Economisch Plan, 1979, 1984

This paper studies the consequences for variables such as the rate of unemployment and the level of output of introducing an automatic link between the level of benefits and private sector wage rates in the context of an economy where an encompassing trade union or trade union federation exerts a major influence on wage setting. The emphasis in the paper lies on showing the (de)merits of an automatic link between unemployment benefits and private sector wage rates without focussing on a specific historic context such as the one sketched above. This implies abstraction of phenomena such as the possible coincidence of introducing a benefits wage rate link at the same time as a commodity bonanza occurs, the smoothing out of fiscal adjustment over time (e.g. deficit financing)

or the possible mal reaction to changed circumstances by the government or the trade union federation.

Attention is therefore focussed on the effects of an automatic benefits wage rate link in a non-stochastic environment, because it should be clear that in a stochastic environment it is in general not sensible for the government to give up a policy instrument, such as the level of benefits. An optimal reaction to unforseen events such as an oil-price shock normally requires a change in all policy instruments. Giving up any one instrument implies therefore that a sub-optimal mix of instruments is used which will result in utility loss.[0] This is however thought to be such an obvious point that it is not elaborated in the paper.

The set up chosen in this paper is one in which a monopoly trade union federation sets the wage rate first after which the firms set the level of employment. The trade union federation can therefore be regarded as the Stackelberg leader in the game with the firms. The trade union federation is simultaneously involved in a non cooperative game with the government. The trade union federation sets the wage rate in this game at the same time the government sets the level of public sector employment, the level of unemployment benefits and the tax rate on labour income. A Nash solution is supposed to apply for this latter game. Both the government and the trade union federation take each others behaviour therefore as uninfluentiable by themselves through strategic behaviour. The government has no direct form of interaction with the firms, though it influences their behaviour indirectly through its effect on the wage setting process. The set up is confined to one period, so the government is bound by a simple a-temporal budget constraint. In reality governments extend budgetary adjustments over more than one period, but abstraction of this smoothing of changes over time does not alter the conclusions of this paper.

In assuming an encompassing trade union which dominates the wage setting process, the paper follows the Scandinavian tradition Calmfors 1982, 1985, Hersoug 1985 etc.), though it abstracts from open economy phenomena. The paper strives for some more consistency than most papers (e.g. Calmfors 1985, Sampson 1983) in the sense that not only trade union but also government behaviour is based on explicit optimization.

This paper is organized as follows. Section 2 deals with the trade union federations behaviour. Section 3 is concerned with the effect of an automatic benefits wage rate link on the trade union federations behaviour. Section 4 deals with the governments behaviour whereas section 5 focusses on the effect of an automatic benefits wage rate link on the its behaviour. In section 6 attention is turned on the interaction between the governments and the trade union federations behaviour. Section 7 concludes the paper.

2. The Trade Union Federations Behaviour

Consider the following aggregate labour demand curve,

$$\ell = L(w) \qquad \text{with: } L'<0 \qquad (2.1)$$

This labour demand curve has the usual properties; labour demand ℓ, is decreasing in the gross wage rate w. It results from optimizing behaviour on the part of firms; firms that maximise their revenue function with respect to their labour input. For simplicity it is assumed that firms take the wage rate as given and that the trade union federation unilaterally determines the wage rate w. This implies that the monopoly union model is assumed to apply (McDonald and Solow 1981).

The trade union federation cares about income and the level of employment. Such preferences of the trade union federation allow for various specific possibilities regarding its utility function. The trade union federation might be supposed to maximise the wage bill $w\ell$ (Dunlop 1944), total rent, that is the surplus of income over the wage bill under perfect competition (De Menil 1977), or a more general Stone-Geary utility function that allows for subsistence levels of wages and employment and the importance of supernumerary wages and employment (Pencavel 1984).

Here it is assumed that the trade union federation maximises a utilitarian utility function with respect to the gross wage rate and subject to the labour demand curve (2.1) (McDonald and Solow 1981; Oswald 1982a, 1985, van der Ploeg 1986),

$$\underset{w}{\text{Max}} \quad U = (\ell+g)u((1-t)w) + (n-\ell-g)u((1-t)b), \; u'>0, \; u''<0 \qquad (2.2)$$

where n denotes the size of the labour force, b the level of real unemployment benefits, t the labour tax rate, which can be taken to comprise wage taxes, employers and employees social security contributions, indirect taxes and the like (see Layard and Nickell 1986) and g denotes the number of public sector employees, which are paid competetive wages (i.e. wages which are comparable to the private sector). The advantage of this specification is that it has a micro economic foundation

and can be derived from aggregating the preferences of two groups of employed and unemployed workers with risk averse ($u''<0$) or riskneutral ($u''=0$) preferences. If the level of the trade union federations membership is fixed, the approach is equivalent to an expected utility approach, where $(\ell+g)/n$ is the probability of a member of the trade union federations reference group to be employed and $(n-\ell-g)/n$ the probability to be unemployed.

The monopoly trade union federation is not just involved in a game with the firms and their representative organization, but is also involved in a game with the government. This latter game is assumed to be a noncooperative game where the actors adopt Nash strategies and find the accompanying equilibrium. The trade union federation therefore maximises its utility function given the tax rate t, the level of benefits b and the the level of public sector employment g. This leads to the following expression for the trade union federations behaviour provided that the second order condition[1] for an optimum is satisfied $U_{ww}<0$,

$$U_w = L'(w)[u((1-t)w) - u((1-t)b)]$$

$$+ (1-t)(\ell+g)u'((1-t)w) = 0 \qquad (2.3)$$

Equation (2.3) expresses that the trade union federation equates the utility loss $[u((1-t)w) - u((1-t)b)]$, for the workers who become unemployed $L'(w)$, as a result of a rise in the wage rate to the marginal gain in utility $(1-t)u'((1-t)w)$, for the employed $(\ell+g)$, of such a rise in the wage rate. In other words, the union sets as a typical monopolist a markup of $u((1-t)w)$ over $u((1-t)b)$ that is an inverse function of the elasticity of demand for labour ($e_{\ell+g} = \frac{wL'(w)}{\ell+g}$) that the trade union federation faces.

If the second order condition for a maximum is satisfied and a solution exists, then the model can be solved for the gross wage rate as a function of the level of benefits, the tax rate and public sector employment,

$$w = W[g,b,t], \quad W_j = - U_{wj}/U_{ww} \qquad (2.4)$$

The effects of changes in the tax rate respectively the level of benefits on the gross wage rate can be determined from (2.3) using the implicit function theorem (see equation (2.4) as:

$$W_g = - (1-t)u'((1-t)w)/U_{ww} > 0 \qquad (2.5)$$

$$W_b = (1-t)L'(w)u'((1-t)b)/U_{ww} > 0 \qquad (2.6)$$

$$W_n = 0 \qquad (2.7)$$

and,

$$W_t = L'(w)\{wu'((1-t)w) - bu'((1-t)b)\}/U_{ww} +$$

$$(\ell+g)\{u'((1-t)w) + (1-t)wu''((1-t)w)\}/U_{ww} \qquad (2.8)$$

Most of these results are well known (e.g. McDonald and Solow 1981, Oswald 1982a, Sampson 1983[2], VanderPloeg 1986, Calmfors 1982).

An increase in public sector employment shifts the labour demand curve out and reduces the absolute value of the demand for labour elasticity ($|e_{\ell+g}|<|e_{\ell}|$). This reduction in the wage sensitivity of the demand for labour elasticity makes it more attractive for the trade union federation to raise the wage rate ($W_g>0$)[3]. A rise in unemployment benefits reduces the gap between an employed and an unemployed member's utility and therefore reduces the marginal opportunity cost for the trade union federation of raising the wage. In other words the trade union federation places, at the margin, less value on jobs than on income and consequently demands a higher wage rate ($W_b>0$). A change in labour supply does not change the desired wage, because neither the marginal benefit nor the marginal cost to the trade un on federation from raising the wage rate depends on the labour supply ($W_n=0$). A higher tax rate has an ambiguous effect on the gross wage rate desired by the trade union federation. Note that equation (2.4) implies that the trade union federation equates the utility loss of the workers who become unemployed to the marginal gain in utility for the employed. Now higher taxes reduce the first term, the utility loss for the workers who become unemployed ($wu'((1-t)w)$ is for

most reasonable utility functions such $u(x) = x^a$, $a<1$, larger then $bu'((1-t)b))$. This makes the trade union federation emphasize the wage rate. The effect of higher taxes on the second term, the marginal gain in utility for the workers who remain employed, is positive if the trade union federation is sufficiently risk averse ($\frac{1}{(1-t)w} > \frac{u''((1-t)b)}{u'((1-t)w)}$) because a high degree of risk aversity implies that the after tax marginal utility gain for the remaining workers goes up if the tax rate goes up. Consequently the trade union federation will put more emphasis on a pay rise. The degree of risk aversity is therefore decisive for the effect of a rise in the tax rate on the wage rate desired by the trade union federation.

The behaviour of a monopoly trade union federation facing a downward sloping demand curve and taking the level of public sector employment, the benefit level and the tax rate as given has been characterised in this section. Next attention will be focussed on a trade union federation in a similar situation except for the fact that benefits are linked automatically to private sector wage rates.

3. The effect of an automatic benefits wage rate link on the trade union federations behaviour

Consider now the situation where a binding law has been passed, which can not be changed except at great political costs and which states that unemployment benefits b, are automatically linked to the private sector wage rate w. In other words the government fixes the replacement ratio instead of the level of benefits. This changes the situation for the trade union federation outlined in section 3 above, as follows; if the trade union federation[4] negotiates a higher gross wage rate this will result in a higher level of benefits as well.

Maximisation by the trade union federation of its utility function (2.2) subject to the labour demand curve (2.1), a linear link between the the level of benefits and private sector wage rates (b=qw) and given the tax rate and the replacement ratio q, gives;[5]

$$U_w^1 = L'(w)[u((1-t)w) - u((1-t)qw)] +$$

$$(1-t)[(\ell+g)u'((1-t)w) + q(n-\ell-g)u'((1-t)qw)] = 0 \quad (3.1)$$

where,

$$q = \frac{b}{w} = \frac{(1-t)b}{(1-t)w} \quad (3.2)$$

and the super script 1 in U_w^1 denotes that unemployment benefits are linked to real wage rates. Comparing this result with the 'no link' situation described in the previous section (notably with equation (2.3)) it is clear that the markup of the net wage rate over the the net level of benefits, u((1-t)w) over u((1-t)b), is now not only an inverse function of the demand for labour elasticity that the trade union federation faces but also a positive function of the replacement ratio q and the number of unemployed $(n-\ell-g)$. The trade union federation makes the loss of utility for the workers who become unemployed as a result of the rise in the wage rate equal to the combined gain in utility for the employed and the unemployed. These gains in utility result because a rise in the

gross wage rate makes both the net wage rate for the employed and the net level of benefits for the unemployed go up, given the tax rate. A first impression about the difference between the behaviour of the trade union federation in the 'link' versus the 'no-link' situation is that because of the extra gain in utility resulting from a rise in the wage rate in the 'link' situation, the trade union federation will set the wage rate higher and will be better off in the 'link' situation. The correctness of this impression will be the subject of propositions 1 and 2 discussed below. First attention is focussed on some of the comparitive static properties of the trade union federations behaviour and comparison of these properties with the 'no-link' situation.

Equation (3.1) can be solved for the optimal wage rate to give

$$w = W^1\{g,q,n,t\},\ W_j = -\ U^1_{wj}/U^1_{ww} \tag{3.3}$$

from which the effects of changes in the variables g, q, n, and t on the wage rate can be deduced using the implicit function theorem as,

$$W^1_g = -\ \{(1-t)[u'((1-t)w) - qu'((1-t)qw)]\}/U^1_{ww} \tag{3.4}$$

$$W^1_q = -\ \{(1-t)(n-\ell-g)[u'((1-t)qw) + (1-t)qwu''((1-t)qw)]\}/U^1_{ww}$$

$$+\ \{(1-t)wL'(w)u'((1-t)qw)\}/U^1_{ww} \tag{3.5}$$

$$W^1_n = -\ \{(1-t)qu'((1-t)qw)\}/U^1_{ww} > 0 \tag{3.6}$$

and,

$$W^1_t = \{wL'(w)[u'((1-t)w) - qu'((1-t)qw)]\}/U^1_{ww} \tag{3.7}$$

$$\{(\ell+g)u'((1-t)w) + q(n-\ell-g)u'((1-t)qw)\}/U^1_{ww}$$

$$\{(1-t)w[(\ell+g)u''((1-t)w) + q^2(n-\ell-g)u''((1-t)qw)]\}/U^1_{ww}$$

An increase in public sector employment reduces just like in the 'no-link' situation (equation (2.5)), the absolute value of the demand for

labour elasticity but now such an increase reduces the gain in utility for the unemployed resulting from the rise in the wage rate as well. For most reasonable utility functions the first effect will dominate and the trade union federation will increase its wage demands if public sector employment goes up ($W_g^1>0$). A higher replacement ratio q, reduces on the one hand the gap between an employed and an unemployed members utility and on the other hand changes the marginal benefit for the unemployed $(q(n-l-g)u'((1-t)qw)$, of raising the wage rate. The first effect is positive and the latter effect is ambiguous. Again, for most reasonable sub utility functions the first, positive, effect will dominate ($W_q^1>0$). A rise in labour supply ceteris paribus the wage rate enlarges the number of unemployed and makes it for the trade union federation more attractive to raise the wage rate and thereby make the level of benefits go up ($W_n^1>0$). A growing labour force therefore has an unbalancing effect in an economy with a fixed replacement ratio, because it makes the wage rate go up. A higher tax rate has an ambiguous effect on the gross wage rate in the 'link' situation too. Higher taxes reduce the utility loss of the workers who become unemployed as a result of a marginal rise in the wage rate if $wu'((1-t)w)$ is larger then $bu'((1-t)b)$ which is the case for most reasonable utility functions such $u(x) = x^a$, $a<1$). This makes the trade union federation put more emphasis on the wage rate. The effect of higher taxes on the marginal gain in utility for the workers who remain employed and the unemployed who remain unemployed is positive if the trade union federation is sufficiently risk averse ($\frac{1}{(1-t)w} > \frac{u''((1-t)b)}{u'((1-t)w)}$) because a high degree of risk aversity implies that the after tax marginal utility gain for the remaining workers goes up if the tax rate goes up. Consequently the trade union federation will put more emphasis on a pay rise. The degree of risk aversity is therefore decisive for the effect of a rise in the tax rate on the wage rate desired by the trade union federation.

Comparing the outcomes of the wage setting under the 'link' situation, described by equations (2.1) - (2.2) and (3.1) - (3.2), and the 'no-link' situation described by equations (2.1) - (2.3), one can formulate the following proposition about the introduction of a benefits wage rate link.

Proposition 1 : The wage rate is set higher in the situation where there is a positive automatic benefits, wage rates link, if the tax rate and the level of government employment is the same as in the situation where there is no such link if the ratio of the level of benefits over the private sector wage rate is the same as in the situation where there is no such link
and if the second order condition for the 'no-link' situation ($U^1_{ww}<0$) is satisfied for the wage rates that solve the trade union federations wage setting problem in both the 'link' and the 'no-link' situation, and the wage rates lying in between these wage rates in magnitude.

See Appendix A for a proof and a more formal version of this proposition.

The result described in proposition 1 is not unexpected and conforms with the intuitive result described earlier in this section. Since benefits rise along with the wage level in the 'link' situation, the trade union federation has an extra incentive to push up the wage rate.

From proposition 1 it follows suite that since the wage rate is smaller in the 'no-link' situation, the level of employment is higher (the demand for labour curve is downward sloping in the wage rate. From this it follows that the unemployment rate is smaller in the 'no-link' situation, while the level of economic activity is higher. Given the tax rate, the net wage rate and the after tax level of benefits will be higher in the situation with an automatic link between unemployment benefits and private sector wage rates. Given the tax rate and the number of public sector employed the trade union federations utility will therefore be higher as well in the 'link' situation (otherwise the trade union federation would not raise the wage rate).

But how restrictive are the conditions required for these results? The second if condition in the proposition makes the 'link' and the 'no-link' situation comparable. The third if condition is very likely to hold because it just requires that the second order condition for an optimum in the 'link' situation holds for a wage rate between the wage that prevails in the 'link' situation and the wage rate that prevails in the

'no-link' situation. The first if condition, that the governments behaviour does not change is however rather restrictive and this is the subject of discussion of the next section. This discussion will lead to another proposition (proposition 2) that does not rely on this if condition.

4. The Governments Behaviour

The if condition in proposition 1 that the government will not change the tax rates or the level of public sector employment if an automatic link between benefits and private sector wage rates is introduced, is not likely to hold. The fact that the number of unemployed goes up and the level of benefits increases makes it rather unlikely that the tax rate and the number of public sector employees remains unchanged, because that would presumably lead to an increasing budget deficit (increasing because of the interest payments on the deficits). More generally an optimizing government involved in a Nash game with the trade union federation will change the mix of its instruments if any of the variables exogenous to its behaviour changes. The labour tax rate and the level of government expenditures are in such a case endogenous variables which are reduced form functions of the wage rate set by the trade union federation, the size of the labour force and for example variables which shift the labour demand curve but are omited here for simplicity.

In order to endogenize the tax rate and the number of public sector employees an objective function for the government is specified in this section. The resulting government reaction functions (or Nash strategies), will be combined with the trade union federations reaction function (or Nash strategy) and the labour demand curve to characterise the reduced form effects of introducing an automatic link between unemployment benefits and private sector wage rates.

The government is assumed to aim at reelection by caring about the utility and perceived relations of a representative voter. The utility of this representative voter depends on consumption of private sector and public sector goods. Consumption of private sector goods in turn depends on expected income from labour and on unemployment (benefits). The representative voter is risk averse and is therefore not indifferent between labour income and income from unemployment. The perception of the reoresentative voter about the effect of the government on its consumption level is assumed to be related to the tax rate. Maximisation of the following seperable objective function is regarded as an approximate solution for the governments reelection problem.

$$\underset{g,t,b}{\text{Max}} \quad V(\frac{wl}{n}, \frac{g}{n}, t, \frac{b}{w}) \tag{4.1}$$

where,

$$V_1>0,\ V_2>0,\ V_3<0,\ V_4>0,\ V_{11}<0,\ V_{22}<0,\ V_{33}<0,\ V_{44}<0$$

So the governments reelection platform consists of raising the wage bill and thereby consumption of private sector goods, enlarging consumption of public sector goods, increasing benefits as a percentage of real wages (to comply with the risk aversity of the representative voter) and reducing the tax rate (to deal with the perceived negative effect of the tax rate by the representative voter). The objective function (4.1) encompasses a simple 'representative consumer' objective function ($V(\frac{wl}{n}, \frac{g}{n})$, see e.g. Turnovsky and Brock 1980).[6] In achieving its goals the government is bound by a budget constraint,

$$-tw(l+g) + (1-t)b(n-l-g) + gw = 0 \tag{4.2}$$

This budget constraint states that tax income has to be equal to government expenditures on benefits for the unemployed and on salaries for the public sector labour force. Note that the unemployed ($n-l-g$) are granted real gross benefits b, while the public sector employed get the same pay as the private sector employed.

Maximisation of the governments objective function, subject to the budget constraint (4.2), the labour demand curve (2.1) and given the wage rate gives, provided that the bordered Hessian is positive ($|\bar{H}|_g^1>0$),

$$[w(l+g) + b(n-l-g)]\frac{dV}{dg}\frac{1}{n} + (1-t)(w-b)\frac{dV}{dt} = 0 \tag{4.3}$$

and,

$$[w(l+g) + b(n-l-g)]\frac{dV}{dg}\frac{1}{w} + (1-t)(n-l-g)\frac{dV}{dt} = 0 \tag{4.4}$$

which expressions can together with the budget constraint be solved for government reaction functions, regarding the size of the public sector labour force, the level of benefits and the tax rate.

$$g = G\{w,n\},\ b = B\{w,n\},\ t = T\{w,n\} \qquad (4.5)$$

The derivatives of these government reaction function can be determined using the implicit function theorem and Cramer's rule. The signs of the derivatives with respect to the wage rate can not be determined however without further restrictions on the governments objective function (4.1)[7]. But determinate signs of these effects for this 'no-link' situation are not necessary to obtain results about the effects of introducing a benefits wage rate link because one does not need to solve for the level of benefits as the discussion in section 6 will show. First the governments behaviour in the 'link' situation will be described however.

5. The effect of an automatic benefits wage rate link on the governments behaviour

Consider again the situation where a binding law has been passed which states that unemployment benefits b, are automatically linked to the private sector wage rate w. This law binds the hands of the government by making her forgo the free use of an instrument. The government looses the level of benefits as an instrument to achieve its goals.

The governments problem is to maximise its objective function (4.1) subject to the budget constraint (4.2), the labour demand curve (2.1) and the constraint on its benefit setting behaviour imposed by the 'automatic link' law (3.2). Note that the government can not use the replacement ratio as an instrument. Solving this problem yields, provided that the bordered Hessian is positive ($|\bar{H}|_g^1 > 0$),

$$[w(\ell+g) + wq(n-\ell-g)]\frac{dV}{dg}\frac{1}{n} + (1-t)(w-wq)\frac{dV}{dt} = 0 \qquad (5.1)$$

where $\ell = L(w)$ and the tax rate can be substituted using the governments budget constraint equation (4.2). This optimality condition for the governments behaviour (5.1) is the same as one of the optimality conditions for the governments behaviour in the 'no-link' situation namely equation (4.3), if the level of benefits in the 'no-link' situation is set at the equilibrium level of the 'link' situation. The reason for this similarity in outcome is that the level of benefits (b=qw) is exogenous with respect to the tax rate and the level of public sector employment, since the replacement ratio is fixed and the government regards the wage rate w, as given in determining its optimal (Nash) strategy. This result implies that if the wage rate and the ratio of benefits over the wage rate q, is the same in the 'link' situation as in the 'no-link' situation, the government will set government expenditures and the tax rate at the same level in the 'link' situation as in the 'no-link' situation.[8] According to proposition 1 however, the trade union federation will set a different wage rate in the 'link' situation under these conditions. The governments behaviour will therefore change after the introduction of an automatic benefits, private sector wage rate link, firstly if the ratio of benefits over the wage rate was fixed at a level different from the

'no-link' situation which is obvious and second because the trade union federations behaviour will change as a reaction to the introduction of the 'link' law.

The optimality condition equation (5.1), the budget constraint (4.2) and the 'link' law (3.2) can be solved to yield the (Nash) government reaction functions for the 'link' situation,

$$g = G^1\{w,n,q\},\ t = T^1\{w,n,q\} \tag{5.2}$$

of which the derivatives with respect to the wage rate can be determined using the implicit function theorem and Cramer's rule as,

$$G^1_w = \{(1-t)(1-q)w[-wL'(w)\frac{dV}{dt} + \frac{1}{1-t}\frac{1}{1-q}AT_w|\}/|\bar{H}|^1_g \tag{5.3}$$

and,

$$T^1_w = -I_w[w(\ell+g) - q(n-\ell-g)]\frac{d^2V}{dg^2}/|\bar{H}|^1_g$$

$$- \{(1-t)^2(1-q)^2w^2[w(\ell+g) - q(n-\ell-g)]$$

$$[2w(\ell+g) - 2q(n-\ell-g) + wL'(w)(1-q)]\frac{dV}{dt}\}/|\bar{H}|^1_g \tag{5.4}$$

where:

$$I_w = t(\ell+g) + [t+(1-t)q]wL'(w) - g - (1-t)q(n-\ell-g) < 0 \tag{5.5}$$

$$A = \{-(1-q)\frac{dV}{dt} + (1-t)(1-q)\frac{d^2V}{dt^2}\}\ (>0) \tag{5.6}$$

$$B = \{(1-q)\frac{dV}{dg} + [(\ell+g) + q(n-\ell-g)]\frac{d^2V}{dg^2}\}\ (>0) \tag{5.7}$$

and,

$$|\bar{H}|^1_g = -w^2(1-t)(1-q)A - w^2[(\ell+g) + q(n-\ell-g)]B > 0 \tag{5.8}$$

In order to discuss the signs of the derivatives of the government reaction functions, it is convenient to determine first the signs of some of the effects which show up in all equations;

I_w: I_w shows how net government income reacts to a change in the wage rate given public sector employment g, and the ratio of benefits over the wage rate q, i.e. it shows the effect of the budget constraint. A rise in the average wage level implies first of all extra tax revenues from existing private sector workers l, second a loss of tax income from the people who become unemployed because of the rise in the wage rate, third extra expenditures in the form of unemployment benefits for these extra unemployed and fourth extra expenditures in the form of a higher wage bill for the government employees and people who are already unemployed because there salaries resp. their benefits are linked to the private sector wage rate. The latter three effects can be shown to dominate and an increase in the gross wage rate will therefore lead to a reduction in net government income $I_w<0$.

$|\bar{H}|_g^1$: A positive bordered Hessian $|\bar{H}|_g^1$ is the second order condition for the governments optimization problem in this 'link' situation and this condition is assumed to be fulfilled. A sufficient condition for $|\bar{H}|_g$ to be positive is that both A and B are negative.

If the sufficient conditions for an optimum are fulfilled (A>0, B>0), then the government will reduce its workforce if it is confronted with a rise in the private sector wage rate ($G_w^1<0$), whereas the effect on the tax rate is indeterminate ($T_w^1 \gtrless 0$).

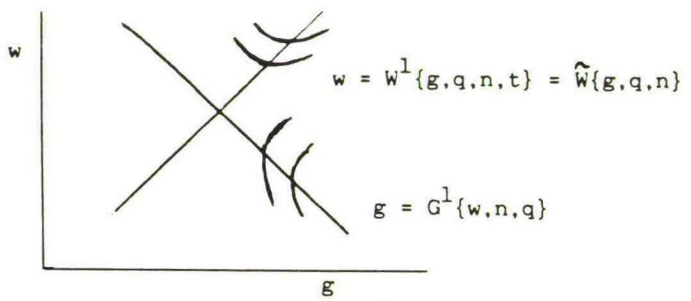
These results follow in a plausible way from the governments objective function and its budget constraint. When the wage rate goes up the net expenditures of the government will increase ($I_w<0$). In order to balance its budget, the government has to undertake corrective actions. The government has two instruments available for corrective action, a reduction in public sector employment and an increase in the tax rate. (The government can not reduce benefits because it is bound by the 'link' law, nor can it use the wage rate as an instrument because it can not influence the wage rate in a direct way.) Of the two instruments available, the government will defenitely use the first one and cut back on public sector employment. This happens because of the shape of the governments utility function in which g and -t are treated as normal goods. The reduction in tax income resulting from a rise in the wage rate has two

opposite effects on the tax rate setting behaviour by the government. On the one hand the government will want to raise the tax rate to make up for the loss of tax income but on the other hand the government wants to reduce the taxe rate since it regards the tax rate as a normal good and as the government wants to cut back on public sector employment it will like to reduce the tax rate as well.

6. The interaction between the governments and the trade union federations behaviour in the benefits wage rate link situation

The interaction between the (Nash) trade union federations reaction function and the (Nash) governments reaction function in the 'link' situation can be graphically depicted as follows:

Figure 1. The trade union federations and the governments reaction functions



The point where the two reaction functions cross is the Nash equilibrium. Note that the reaction functions exist of the points at which horizontal respectively vertical lines are tangent to the trade union federations respectively the governments utility function. This comes about because the government maximises its objective function given the wage rate and the union maximises its utility function given the size of the public sector labour force and the tax rate. From equation (3.4) follows that it is rather likely that the trade union federations reaction function slopes upward, which is defenitely so if the trade union federation is risk neutral and $u(x)$ is x. From equation (5.3) it is clear that the governments reaction function slopes downward if the sufficient conditions for an optimum are fulfilled. It follows from the way the reaction curves slope that both the trade union federation and the government would benefit if the government would be the Stackelberg leader in the underlying game.

Proposition 2: The wage rate is set higher in the situation where there is a positive automatic benefits, wage rates link, if the

trade union federation is risk-neutral (the sub utility function is of the simple $u(x) = x$ form), if the ratio of benefits over the wage rate in the 'link' situation is set at the same level as in the 'no-link' situation and if a solution exists for both the 'link' and the 'no-link' situation.

Proof[8]: Take the following system of equations which describes the Nash equilibrium for the 'link' situation in case of the assumed simple version of the trade union federations sub-utility function, consisting of the optimality conditions (3.1) and (5.1) for the trade union federations respectively the governments behaviour and the budget constraint (4.2) (note that $(u'(w)=1)$,

$$\frac{1}{1-t}\, U^1_w = L'(w)[w - qw] + [(\ell+g) + q(n-\ell-g)] + x = 0 \qquad (6.1)$$

$$[(\ell+g)+q(n-\ell-g)]\,\frac{dV}{dg}\,\frac{1}{n} + (1-t)(1-q)\,\frac{dV}{dt} = 0 \qquad (6.2)$$

$$-tw(\ell+g) + (1-t)qw(n-\ell-g) + gw = 0 \qquad (6.3)$$

where $\ell = L(w)$ according to equation (2.1). This system of equations determines the equilibrium values of the wage rate, the level of public sector employment g, and the tax rate t, in terms of the exogenous variables q and n (respectively the ratio of benefits over the wage rate and labour supply) for the 'link' situation provided that x is nil. In case of the 'no-link' situation $x = -q(n-\ell-g)$ and $q = \frac{b}{w}$ Denote the equilibrium values of the endogenous variables in the 'no-link' situation as b_N, w_N, t_N, g_N, and ℓ_N. If $x = -q(n-\ell_N-g_N)$ and $q = \frac{b_N}{w_N}$, then the system of equations (6.1) - (6.3) will replicate the equilibrium values b_N, w_N, t_N, g_N, and ℓ_N. Starting from these values for x and q, the effects of introducing an automatic benefits, wage rate link on the endogenous variables b, w, t, g, and ℓ, can be computed by calculating the effects of a fixed impulse dx with the magnitude $\frac{b_N}{w_N}(n-\ell_N-g_N)$ on the above system of equations, while keeping the exogenous variable n constant. The system of equations can be solved for the following reduced form equations,

$$g = G^{s}\{n\},\ w = W^{s}\{n\},\ t = T^{s}\{n\}, \tag{6.4}$$

Using the implicit function theorem and Cramer's rule, the effects of introducing an automatic benefits, wage rate link at ratio $\frac{b_N}{w_N}$, can therefore be calculated from,

$$\frac{dy}{dz} = \frac{|J_j|_z}{|J|},\ y\in\{w,g,t\},\ z\in\{x,n\}, \tag{6.5}$$

as,

$$W^{s}_{x} = -\frac{|\bar{H}|^{1}_{g}}{|J|} > 0 \tag{6.6}$$

$$G^{s}_{x} = -\frac{AI_{w} + C}{|J|} < 0 \tag{6.7}$$

and,

$$T^{s}_{x} = \frac{-(1-t)(1-q)^{2}wL'(w)\frac{dV}{dg} - BI_{w}}{|J|} \tag{6.8}$$

where, I_w, A, B and $|\bar{H}|^{1}_{g}$ are described by equations (5.5) - (5.8) and,

$$C = -[w(\ell+g) + q(n-\ell-g)](1-q)L'(w)\frac{dV}{dg} > 0 \tag{6.9}$$

$$|J| = U^{1}_{ww}|\bar{H}|^{1}_{g} - (1-q)C - (1-q)B \quad (<0) \tag{6.10}$$

The first term in $|J|$ is the multiple of U^{1}_{ww} and $|\bar{H}|^{1}_{g}$. As U^{1}_{ww} is the second order condition for the trade union federations maximisation problem in the 'link' case and a positive bordered Hessian $|\bar{H}|^{1}_{g}$, is the second order condition for the governments maximisation problem in this case the first term will be negative. The second term is negative as well and the third term is negative too if the sufficient conditions for the governments maximisation problem are satisfied (A<0, B<0).

If the necessary and sufficient conditions for the trade union federations respectively the governments optimization problem are fulfilled ($A<0$, $B<0$, $U^1_{ww}<0$) and $|J|$ and $|\bar{H}|^1_g$ are therefore negative resp. positive, then an increase in x has a positive effect on the wage rate ($W^s_x>0$) and a negative effect on public sector employment ($G^s_x>0$). In other words the effect of introducing a benefits wage rate link on the wage rate is positive and on public sector employment it is negative.

It follows suite from proposition 2 that under the stated conditions, the introduction of a benefits wage rate link will lead to a reduction in private sector employment ($L'(w)<0$), whereas the level of benefits will go up (from $b = qw$) and the unemployment rate will increase. The effect on the tax rate is indeterminate, just like the effects of a change in the tax rate on the trade union federation and the governments reaction functions.

The economics of these results are similar to the economics of proposition 1. in as far the trade union federations behaviour is concerned. Introduction of the benefits wage rate link changes the opportunity costs for the trade union of increasing the wage rate given the tax rate and the level of government employment. In the proposition which is now under discussion this ceteris paribus condition is dropped. The effect of a higher wage rate on the governments behaviour is to reduce its net income ($I_w<0$) and make the government cut back on expenditure on government employment ($AT_w + C <0$). This will happen because of the shape of its utility function which treats g and t as normal goods. The reduction in tax income resulting from a rise in the wage rate will have two opposite effects on the tax rate setting behaviour by the government. First a sort of income effect. Tax rates will rise to make up for the loss of tax income and second as taxes are regarded as a normal good they will go down for the same reasons the government will cut back on public sector employment. The positivity of $|J|$ ensures that the interaction of trade union and government behaviour will not lead to perverse effects. It excludes the possiblity that the ceteris paribus g and t rise in the wage rate set by the trade union federation will lead to such a large reduction in government employment that the trade union federation will in effect reduce the wage rate and the government in effect substantially increases public sector employment.

7. Concluding remarks

This paper studies the consequences for variables such as the rate of unemployment of introducing an automatic link between the level of benefits and private sector wage rates in the context of an economy where an encompassing trade union or trade union federation exerts a major influence on wage setting. It is shown that an automatic link between benefit levels and private sector wage rates influences a rational trade union federations behaviour because it increases the incentives for the trade union federation to negotiate higher wage rates; benefits for the unemployed will go up if the trade union federation negotiates a higher wage rate. In reaction to such a change in the trade union federations behaviour a rational government will change its behaviour as well. A rise in the private sector wage rate will lead to a reduction in net tax income over net expenditure. The government will react to the worsened budget situation by cutting its expenditure on public goods and by changing its tax rates. The overall effect of introducing an automatic link between benefit levels and private sector wage rates at the going ratio between benefits and private sector wage rates will be that the gross wage will go up and both public and private sector employment will go down.

Footnotes

0. A major reason for which the fixing of an instrument would result in a welfare improvement would be if one could thereby avoid or reduce the inefficiencies resulting from a time inconsistency problem (for example by fixing the money stock in Barro and Gordon 1983), but a time inconsistency does not seem to arise in the context discussed in this paper.

1. The second order condition for the unions optimization problem can be written as:

$$U_{ww} = L''(w)[u((1-t)w) - u((1-t)b)] + 2(1-t)L'(w)u'((1-t)w)$$

$$+ (1-t)^2(\ell+g)u''((1-t)w)$$

with: $U_{ww}<0$ if $L''(w)<0$

A sufficient condition for a maximum is that the second derivative of the demand for labour function is negative, i.e. that the demand for labour curve is concave to the origin in the relevant area.

2. Sampson obtains, after allowing for different formulations, a defenitely positive sign for the effect of a change in the tax rate on the wage rate set by the trade union federation . This comes about because Sampson uses the net wage rate as the optimizing instrument for the trade union and not the gross wage rate, which seems more appropriate, since the trade union federation has no control over the tax rate and wage contracts with tax clauses are not generally observed.

3. The general idea behind the choice of the set up presented above is that firms are thought to be organized in an employers organization, that negotiates the wage rate with the trade union federation, but has no power over the demand for labour of its members and therefore can

not use the aggregate demand for labour as an instrument in the negotiations. The employees are organized through their trade unions in the trade union federation. This federation is seen to be very powerful in the wage negotiations, because it can employ a domino strategy to convince the firms to accept its wage claims. By way of simplification the trade union federation is therefore assumed to possess all the power in the wage negotiations. Note that this latter assumption does not make a difference for the outcome if 1) the bargaining concept is independent of the variables in the model. For example the bargaining power coefficient in the generalized Nash bargaining solution is fixed or exogenous with respect to the model variables and 2) if the monopoly union solution used in this paper or another exogenous bargaining threshold and for example tge intersection of the labour demand and supply curve are used as bargaining thresholds.

4. This effect will only be present in case of a centralized trade union or trade union federation. If trade unions are organized in a decentralized fashion, they will regard the benefit levels as exogenous and will not change their behaviour.

5. The second order condition for the optimization problem for the trade union federation in the benefits, wage rate link situation is,

$$U^1_{ww} = L''(w)[u((1-t)w) - u((1-t)qw)]$$

$$+ 2(1-t)L'(w)[u'((1-t)w) - qu'((1-t)qw)]$$

$$+ (1-t)^2[(\ell+g)u''((1-t)w) + q^2(n-\ell-g)u''((1-t)qw) < 0$$

with: $U_{ww} < 0$ if $L''(w) < 0$ and $[u'((1-t)w) - qu'((1-t)qw)] < 0$

6. Substitution of the government budget constraint in a simple private sector budget constraint shows that consumption of private sector goods is directly related to $w\ell$.

7. The reason for this result is among other things that an increase in the wage rage is on the one hand likely to reduce the governments net tax income over expenditures which makes her apt to cut back on expenditure on benefit levels and on the other hand will reduce the b/w ratio and will therefore make the government more willing to spend more on benefits. The solution to this dilemma and other dilemmas the government faces depends on the form of its objective function, notably the relative magnitude of the first versus the second order derivatives. Because of the simultaneous nature of equations (3.3) and (3.4) dilemmas for one variable will effect the result for an other variable.

8. The proof is a complicated comparative static proof. The impulse is a change in the nature of the system (the change from the 'no-link' to the 'link' situation) instead of a change in an exogenous variable.

Appendix A: Proof of Proposition 1

Denote with the letter 1 the solution to the wage setting problem in the 'link' situation as defined by equations (2.1) - (2.2) and (3.1) - (3.2), and denote with the letter N the solution to the wage setting problem in the 'no-link' situation as defined by equations (2.1) - (2.3).

Definition: $Z = L'(w)[u((1-t)w) - u((1-t)qw)]$

$$- (1-t)[(\ell+g)u'((1-t)w) + q(n-\ell-g)u'((1-t)qw)] + x = 0$$

where: $\ell = L(w)$

Proposition 1: $w_N < w_1$ if $U^1_{ww} < 0 \quad \forall w \in W\{w_N, \ldots, w_1\}$, $t_1 = t_N$, $n_1 = n_N$ and

$$g_1 = g_N$$

Proof: It follows that q has to be substituted by $\frac{b_N}{w_N}$ and $x = -(1-t)q(n-\ell-g)u((1-t)b) < 0$ in the 'no-link' situation, while $x = 0$ in the 'link' situation. Z is a function of the wage rate w and the variables t, g and n. Holding these latter three variables constant, Z will increase with a rise in the wage rate w if the partial derivative $\frac{dZ}{dw}$ is negative, in other words if the second order condition for a maximum for the trade union federations 'no-link' problem is satisfied in the relevant area $\frac{dZ}{dw} < 0$ is equivalent to $U^1_{ww} < 0$. Now if one starts from the 'no-link' situation and its solution w_N and introduces a benefits wage rate link at level $b_N = qw_N$, then it is clear from $x < 0$ in the 'no-link' situation and $x = 0$ in the 'link' situation that this constitutes a positive impulse to Z. To reach the new equilibrium where $Z = 0$ again the wage rate has to go up since the other variables t, g and n are constant and $\frac{dZ}{dw} < 0$ in the relevant area.

Q.E.D.

What makes this proposition interesting is ofcourse that the if condition is very likely to hold. A negative U^1_{ww} in w_1 is a condition for the existence of a maximum for the trade union federations optimization problem. The propositions require only a marginally stronger condition, namely that U^1_{ww} is positive in the area between w_1 and w_N as well.

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